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RADIOACTIVE WASTE DISPOSAL AND MISCELLANEOUS WORK

ANNUAL REPORT FOR CALENDAR YEAR 1956

H. E. Seagren
E. J. Witkowski

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OPERATIONS DIVISION

RADIOACTIVE WASTE DISPOSAL AND MISCELLANEOUS WORK

ANNUAL REPORT FOR CALENDAR YEAR 1956

By
H. E. Seagren and E. J. Witkowski

Compiled from data by:
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UNION CARBIDE NUCLEAR COMPANY
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RADIOACTIVE WASTE DISPOSAL AND MISCELLANEOUS WORK ANNUAL REPORT FOR CALENDAR YEAR 1956

H. E. Seagren E. J. Witkowski

INTRODUCTION

The main waste-disposal facilities at ORNL, which are under the jurisdiction of the Operations Division, serve the laboratories and operating buildings located in the Bethel Valley area. The first section of this report covers the operation of these facilities, which include the hot-chemical- and the metal-waste systems, the process-waste system (frequently called the "semihot-waste system"), and the radioactive-gas-disposal system, which utilizes the 250-ft stack located in the Radioisotope Area. The report does not cover the disposal of cooling water from the LITR, of gases from the Hot Pilot Plant and the ORNL Graphite Reactor buildings, and of solid wastes at the burial ground.

Certain miscellaneous operations for which the Operations Division is responsible are also covered in this report: SS- (source and special nuclear) material control, SS-material recovery, off-shift services for research divisions, Water Demineralizer Plant operation, and hydrogen liquefaction. Other Operations Division activities, reactor operations, radioisotope production and development, and classified chemical processing are given in separate annual reports.

WASTE-DISPOSAL OPERATING COSTS

The waste-disposal system is operated as a Laboratory service with the main portion of its operating costs indirectly charged to research programs through monthly cost allocations. Some analysis of costs would therefore seem most appropriate and probably would be of general interest to the research divisions.

The total operating cost for 1956, as shown in the Accounting Department's operating reports, was $133,500, with $77,600, or 58% of the total, being basic costs (labor and material). The total cost in 1955 was $175,500, with $98,600, or 56%, representing the basic costs. The apparent reduction in total operating cost in 1956 was therefore $42,000. This decrease, however, does not represent a true saving to the Laboratory; a large portion of it resulted from changes in Laboratory accounting methods used for allocating fixed costs such as utility charges. Since similar changes have also affected total costs in previous years, some indication of operating efficiency can be better demonstrated by considering only the basic costs and comparing them with those for previous years.

Basic cost figures for 1955 and 1956 are given in Table 1. The $30,300 charge for direct labor, supervision, and clerical work represents a cost of $3.45 per operating hour, an increase of 11% over the previous year. The increase is due entirely to wage increases; the manpower requirements remained essentially unchanged. The decrease of $26,000 in engineering and maintenance costs is attributed entirely to the fact that only a portion of one disposal pit was dug in 1956, while one complete pit and a portion of another were dug in 1955. The increase in the cost of supplies in 1956 was due entirely to an increase in the amount of caustic used for neutralizing wastes (primarily from the cesium operation in the former Waste Evaporator Building); a $3000 credit was received from stores for return of material in 1955. The $4300 decrease in analytical costs is due to improvements in work schedules by the analytical laboratory and a 14% reduction in the number of samples for analyses.

Table 1. Liquid-Waste-Disposal Basic Costs for 1955 and 1956

	1956	1955
Direct labor, supervision, and clerical work	$30,300	$27 200
Engineering and maintenance	27,000	53,000
Analytical control	11,100	15,400
Supplies	8,500	−800*
Miscellaneous	700	3,800
Total	$77,600	$98,600

*Stores credit for return of material.

A comparison of basic costs for the last five years follows:

Year	Basic Cost
1956	$77,600
1955	98,600
1954	82,600
1953	97,100
1952	99,200

Some increase in operating costs is expected in 1957 from the startup and operation of the Process-Waste Treatment Plant that is now under construction. Since there has been no experience in a similar operation on which to base an estimate, it is difficult to predict with accuracy what the cost of the new operation will be; however, a rough guess would be about $20,000.

HOT-CHEMICAL-WASTE SYSTEM

Waste Volume and Activity

A total of 2,694,000 gal of waste containing 34,989 curies of "beta activity" was pumped to the waste pits in 1956. This was an increase of 61% in volume and 64% in activity over the previous year. The increases were due to the expansion of the operating activities at the Hot Pilot Plant and the Metal Recovery Plant. Other significant waste-disposal data for 1956 are compared with those of six previous years in Table 2.

The increase in volume is viewed with no concern, since the capacity of the waste-disposal system is far greater than the volumes currently produced and can be limited only by the seepage rates in the three waste pits now in use. Present rates appear to be adequate for several more years, and no further excavation of pits or expansion of the hot-waste-disposal facilities is anticipated unless the present waste-disposal methods are found to be unsafe for wastes produced from some future Laboratory programs such as the Power Reactor Fuel Processing now in the proposal stage.

Tank-Farm Transfer System

The stainless steel underground transfer system, put into operation in 1955, has operated satisfactorily except for frequent failures of the Moyno pump. The failures were attributed to the excessive speed (1140 rpm) required to obtain adequate capacity (900 gph). The Engineering Department recommended that the pump be replaced with one operating at 420 rpm.

A 3000-gph pump with an operating speed of 420 rpm was installed this year. By increasing the capacity, in addition to lowering the operating speed, the use of the pump for another purpose was also made possible; that is, the agitation of wastes in tank W-5, the 170,000-gal concrete collection and storage tank in the chemical-waste system. The only agitator originally provided in W-5 was an air sparger, and it was inadequate for preventing stratification of acid wastes, which would eventually result in damages to the tank. According to an engineering estimate, a separate agitating pump with its auxiliary equipment, which was first considered and then eliminated by this relatively simple pump change, would have cost $60,000.

One section of black-iron pipe, connecting the north and south sections of the tank farm, was not replaced last year, since the high cost of replacement could not be justified because of its infrequent use. It is now damaged by corrosion beyond repair and is no longer in service. Recent estimates indicate that the cost of replacement, which would also involve the building of a new valve pit, would be $60,000. Since the line is now practically never required for normal operations, its replacement has been postponed indefinitely. In the event that an emergency or some unforeseen operations arise that will require transfer between the north and south sections of the tank farm, temporary above-ground lines will be used.

Monitoring Tanks

One 2000-gal stainless steel tank was installed and connected to the chemical-waste system to serve the Graphite Reactor, the LITR, and the ORR buildings. Before this tank was added to the system, the wastes from the Graphite Reactor and the LITR were collected in the same tank with those of the Hot Pilot Plant. Use of a common tank for the three buildings frequently made it extremely difficult to determine the source of abnormal wastes and to exercise some control over them.

One 1000-gal monitoring tank, serving the laboratories in corridors A and B of Buildings 4500 and 4505, developed a leak, apparently from corrosion by HCl, and was taken out of service. A spare tank that was installed with the construction of the 4500 area is now being used in its place.

Prior to the discovery of the leak, an indication of damage was noted when an attempt was made to check the corrosion by inspection of the corrosion

Table 2. Liquid-Waste-Disposal Data for 1950 Through 1956

	1950		1951		1952		1953		1954		1955		1956	
	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta curies")	Volume (gal)	Activity ("beta (curies")
Hot-chemical-waste system														
Radioactive waste received	2,229,000		2,294,000*		2,192,000		2,287,000		1,582,000		1,691,000		2,545,000	
Nonradioactive waste received**	0		0		0		0		87,000		11,000		0	
Radioactive waste evaporated	2,224,000		2,212,000		2,102,000		2,042,000		711,000		0		0	
Disposal in test pit No. 1														
Radioactive waste	0	0	123,000	390	0	0	0	0	0	0	0	0	0	0
Nonradioactive waste	0		0		0		0		0		3,000		0	
Disposal in test pit Nos. 2, 3, 4														
Radioactive waste	0	0	0	0	43,000	953	227,000	7716	910,000	7224	1,674,000	21,391	2,694,000	34,989
Nonradioactive waste	0		0		0		0		87,000		8,000		0	
Process-waste system														
Total waste discharged to White Oak Creek	226,350,000		297,590,000		268,180,000		239,356,000		164,290,000		210,600,000		260,710,000	
Discharged from retention pond		15		3		87		140		17		54		20
Discharged from settling basin		172		169		411		289		237		213		253
Total activity of waste discharged to White Oak Creek		187		172		498		429		254		267		273

*Includes 94,000 gal of metal-waste supernatant transferred directly by truck from metal-waste tanks to tank pit.
**All nonradioactive waste was transferred directly from the operating buildings to the pits by tank trailer.

coupon suspended in the tank; the coupon was lost because the stainless steel wire, used to suspend the coupon, was dissolved in the waste solutions. A survey made among the persons using this portion of the waste-disposal system revealed that corrosion difficulties had also been encountered with the waste lines within the building. A review of the waste conditions with users of monitoring tanks in other sections of the Laboratory revealed that similar difficulties may be encountered with other monitoring tanks because of increases in the use of HCl, even though the coupons thus far have not indicated excess corrosion.

Several methods for preventing future damages to monitoring tanks were considered. The plan that was adopted, because it involved relatively small expenditures and could be adopted in a relatively short period of time without a great deal of inconvenience to research personnel, was to neutralize the acid wastes in the monitoring tanks by maintaining an excess of caustic. To prevent corrosion of pipes in the building, an effort was made to re-educate the people using these services to liberally flush the lines, after use, with water or to neutralize the wastes. At one time, when the wastes were evaporated in an evaporator of limited capacity, it was important to minimize the amount of water used, while the present method of disposal cannot be appreciably affected by additional flushing water.

The neutralization procedure will be put into effect in January 1957. To prepare for this program it was necessary to repair and replace some of the monitoring-tank sampling equipment and to obtain and repair a small tank truck for hauling caustic from the storage tank at the Metal Recovery Building to the monitoring tanks. The small tank truck was obtained from the Metal Recovery operation in exchange for a spare gasoline tank trailer obtained several years ago from AEC surplus equipment. A new loading platform was built at Y-12 in order to allow the Metal Recovery operation to use the gasoline tank trailer for hauling caustic from Y-12 to the storage tank at the Metal Recovery Building.

Waste Evaporator

The waste evaporator, not used since 1954, when the pipeline to the waste pits was put into operation, has been converted to a crystallizer for the separation of Cs^{137} from some of the wastes stored at the tcnk farm.

PROCESS-WASTE SYSTEM

Waste Volume and Activity to White Oak Creek

The activity discharged to White Oak Creek in 1956 was 273 "beta curies," five curies more than in 1955. The only source consistently contributing a large portion of the total activity was the Metal Recovery Building, especially its metal storage canal. The volume of waste was 260,710,000 gal, an increase of 24% over that of last year. As in the case of the hot-chemical-waste volume, the increase is attributed to more steady operations at the Hot Pilot Plant and the Metal Recovery Plant. Other process-waste data for 1956 are compared with those of the previous six years in Table 2.

Process-Waste Treatment Plant

Construction of the lime–soda ash treatment plant was started in August and is scheduled to be completed in March 1957. The primary purpose of this facility is to remove activity from the process water in the event of an accidental spill that would seriously contaminate the Clinch River. At the end of the year, the work was 65% complete and ahead of schedule. The main portion of the construction work is being done by the Moorer Construction Company, with H. K. Ferguson Company doing that portion of the underground work where contamination is probable. The total cost of the project will be approximately $305,000 (see Fig. 1).

RADIOACTIVE-GAS-DISPOSAL OPERATION

Maintenance

Operation of the gas-disposal facilities in 1956 was more trouble-free than in any previous year. The main electrically driven 2400-cfm off-gas blower, which had given the most difficulty with bearing failures at one time, completed 23 months of operation without a single failure. The equipment changes made in 1954, which were responsible for this excellent operating record, included increasing the size of the shaft bearings and changing the lubrication from grease to an oil-mist type.

The standby 2400-cfm steam-driven blower shaft bearings failed once, in October. In an attempt to duplicate the good performance of the primary blower, the bearing lubrication system was also changed to the oil-mist type. At the same time the

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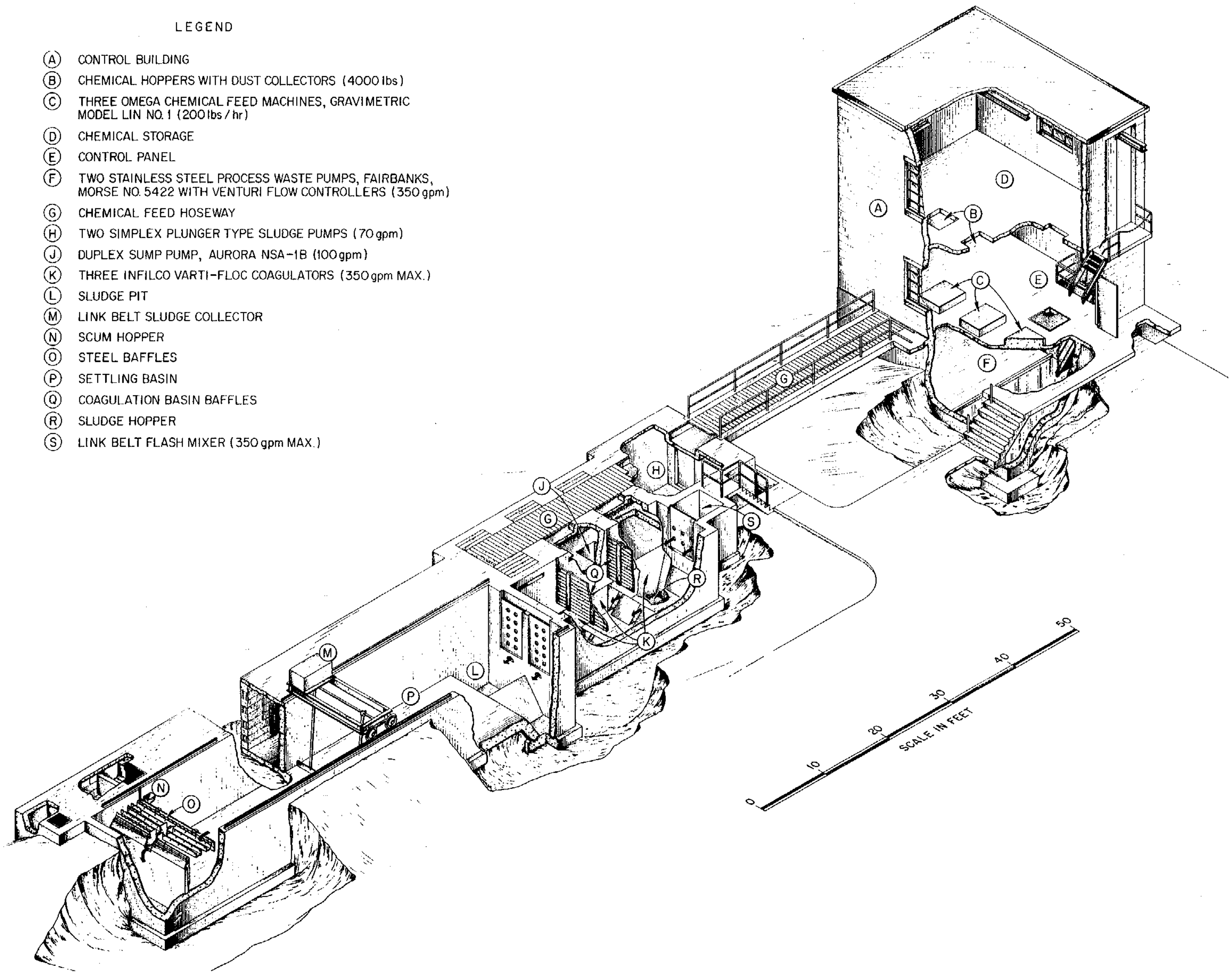

Fig. 1. Process-Waste Treatment Plant.

bearing foundation was reinforced to eliminate some vibration that may also have contributed to the failure.

The 250-ft brick stack was inspected in August by the Consolidated Chimney Company. It was found in good condition except for minor horizontal cracks in the mortar. Arrangements are now being made to contract for the repairs to be made next spring, when the weather will be more suitable.

Continuity of Operation

There were no unscheduled interruptions in cell ventilation or off-gas service this year.

Expansion of Facilities

The $157,000 expansion of facilities planned for the last several years was approved, and construction was started in December, with the work being done by the H. K. Ferguson Company and the Laboratory maintenance forces. Completion of the work is scheduled for July 1957.

The purpose of this project is to improve the presently inadequate cell ventilation and off-gas service to the 4500-area buildings and to tie in the new Fission Product Plant and the Metal Recovery Plant to both services. The ORR and the Solvent Column Pilot Plant, Building 3503, will also be tied in for off-gas service only. The main equipment that will be added will be a 60,000-cfm electrically driven cell ventilation fan and a 2000-cfm electrically driven stainless steel off-gas blower. With the addition of the new equipment, the stack will operate at essentially full capacity.

EQUIPMENT DECONTAMINATION

The amount of decontamination work received this year decreased for the first time since the general decontamination service was made available in 1949. For this reason the basic costs (labor and material) remained the same ($17,900) as in 1955, in spite of increases in salaries and cost of materials. The total cost in 1956 was $43,700, as compared with $37,900 in 1955, with Health Physics charges accounting for $4000 or two-thirds of the increase.

OFF-SHIFT SERVICES FOR RESEARCH DIVISIONS

The labor furnished to the research divisions for miscellaneous services on the 4–12, 12–8, and all weekend shifts was 2.6 man-years, as compared with 2.3 man-years in 1955. The 13% manpower increase was due to an even greater increase in the number of small jobs performed that required less than the average amount of time.

The research personnel are encouraged to take advantage of this service by turning over to the Operations Division some of the part-time routine tasks that may be required on shift. This work is assigned to experienced chemical operators as "fill-in" work at no extra over-all cost to the Laboratory. The divisions requesting service are charged for only the actual time spent on each assignment.

SS-MATERIAL CONTROL

During 1956, a change-over was made from the individual method of accounting for SS materials to a balance-area system. The change was effected March 1, 1956.

Work was started on the revision of the *SF Procedures Manual for Oak Ridge National Laboratory, X-10 Area.* The revised manual will be published during the first half of 1957 and will bear the title *SS Procedures Manual for Oak Ridge National Laboratory, X-10 Area.*

The number of lots of SS materials received in 1956 increased approximately 4% over the number received in 1955. Material requests issued increased approximately 14%, and the number of reports issued increased approximately 6%. A comparison of the number of transactions is given below:

	1955	1956
SS-material receipts, number of lots	437	455
SS-material shipments, number of lots	518	476
Material requests issued	138	157
SS-material reports issued	104	110
Internal audits and surveys	162	113

Although the number of internal audits and surveys was lower than in 1955, the scope of the program was greatly increased. The balance-area system of accounting for SS materials requires a more detailed audit procedure than was necessary previously. For example, one additional person was added to the SS-Material Control Office audit staff to aid in the internal survey program.

Of the 157 requests for materials received during this year, 106 were from ORNL personnel and 51 were from other installations. These materials were either delivered or scheduled for delivery.

Of the 455 shipments received during the year, 23 were carload lots and 42 were trailer-load lots; 37 of the 476 shipments made were trailer-load lots.

The major facilities engaged in processing SS materials were Thorex, Metal Recovery, and the Fabrication Laboratory. The plutonium inventory increased approximately 78% during the year due to the receipt of additional material for recovery in the Metal Recovery Plant. Accelerated delivery of material for the Thorex program accounted for an increase of 104% in the U^{233} inventory. The thorium inventory increased 61% due to the material requirements of the Thorex and blanket programs.

An increase of 46% in the inventory of enriched uranium containing greater than 75% U^{235} was experienced due to enlargement of the scope of work in reactor development and operations and in materials being fabricated at the Rolling Mill. The normal-uranium inventory decreased 46% due principally to the recovery and return of scrap materials to production channels.

All reported SS-material losses and inventory differences were investigated and explained satisfactorily.

A building for the storage of scrap thorium was approved and will be erected during 1957.

A study conducted during the year focused attention on the problems that research personnel have in accounting for small specimens containing SS materials. The study suggests the need of defining fixed limits below which material quantities could be removed from formal accountability.

WATER DEMINERALIZATION PLANT

In Building 3004, the two demineralizer lines produced 4.7 million gallons of water having an average pH of 6 and an average specific resistance of 400,000 ohm-cm. These units operated at about half capacity, producing water which was used as follows:

Facility	Usage (gal/month)
ORNL Graphite Reactor	
Hole 51 cooling	230,000
LITR	
HB-2 cooling	30,000
HB-3 cooling	30,000
HB-4 cooling	30,000
HB-5 cooling	30,000
HB-6 cooling	30,000
Reactor water system makeup	2,000
BSF	
Water system makeup	2,000
Chemical Technology Hot Pilot Plant	9,000
Total	393,000

Ninety-three anion column regenerations were made, using a total of about 1200 gal of 50% technical grade caustic. The average number of gallons passing through an anion unit between regenerations was 38,235. The cation columns were regenerated 25 times, using a total of 13,500 lb of nitric acid. An average of 140,507 gal of water went through the cation columns between regenerations.

In May, the anion resin in the No. 2 anion column was changed completely for the first time since its installation in 1952. The original IRA-410 was replaced with IRA-401, which is a somewhat more porous resin. This change of resin permitted operation of the unit between regenerations at its peak capacity: pH, ~7; specific resistance, 1,000,000 ohm-cm; flow, 50 gpm; capacity, ~45,000 gal.

Because of known future needs, the total capacity of the plant will be increased. In addition to the present usage, the following needs are anticipated:

Facility	Anticipated Usage (gal/month)
ORR	
Water system makeup	160,000
Experiment cooling	250,000
ORNL Graphite Reactor	
Spray cooling of air at a reactor power of 7 Mw	1,100,000
Total (present plus anticipated usage)	1,900,000

The present structure housing the water demineralization plant is considered a fire hazard. It is of frame construction and consists primarily of a high tower, which is no longer used except to house a storage tank. Cost studies are under way on eliminating the tower and replacing the lower part of the structure with a fire-resistant material.